Bachelor Level / First Year/ Second Semester/ Science
Computer Science and Information Technology (STA. 159)
(Statistics II)

Full Marks: 60
Pass Marks: 24
Time: 3 hours.

Candidates are required to give their answers in their own words as far as practicable.
The figures in the margin indicate full marks.

All notations have the usual meanings.

Group A

(2x10=20)

Attempt any two questions:

1. Under which situation probability proportion to size (pps) sampling is an appropriate method for drawing a random sample. Explain the procedure of drawing a random sample in pps sampling plan. In pps sampling with replacement, derive an unbiased estimator of the parameter Y, population total, and, also, derive the variance of the estimator.

2. What do you mean by factorial design? Discuss its role in design of experiment. Obtain main effect and interaction effect in 2^2 factorial design.

3. (a) What do you mean by ANOVA. Explain the underlying assumptions of ANOVA.

(b) Explain the term sampling error and non sampling error.

Group B

Attempt any eight questions. (8x5=40)

4. Suppose it is required to estimate the average value of output of a group of 5000 factories in an industrial area so that the sample estimate lies within 10% of the true value with a confidence coefficient of 95%. Determine the minimum sample size required. It is also known that the population coefficient of variation is 60%.

5. Derive the expression of the sample mean in case of cluster sampling, each cluster containing equal number of element.

6. The following table summarizes population size (N_h) and population variance $\left(S_h^2\right)$ of four strata. Calculate the variance of the stratified estimator $\bar{y}_{st}$ of the population mean for proportional allocation of a total sample size 100.

h	1	2	3	4
N_h	14000	3000	1500	1500
S_h^2	34	94	175	319

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7. In two stage sampling with simple random sampling without replacement (srswor) at both stages, an unbiased estimator of Y is

$$\hat{Y} = \frac{N}{n}\sum_{i=1}^{n}\frac{M_i}{m_i}\sum_{j=1}^{m_i} y_{ij} = \frac{N}{n}\sum_{i=1}^{n} M_i \bar{Y}_i$$

Also derive the variance of the above estimator.

8. In simple random sampling without replacement (N, n), show that the bias of the ratio estimator $\hat{R}$ is approximately equal to :

$$B(\hat{R}) = \frac{1-f}{n\bar{X}^2}(RS_x^2 - \rho S_y S_x) = Rcv(\bar{X})[cv(\bar{X}) - \rho\, cv(\bar{Y})]$$

9. State the mathematical model with the hypothesis to be tested in a two way ANOVA and prepare ANOVA table.

10. Carry out the statistical analysis of m × m latin Square Design (LSD) with one observation per cell.

11. Explain the terms - experimental units, treatments, blocking in design of experiment.

12. Introduce Randomized Complete Block Design (RCBD). Prepare an Analysis of Variance (ANOVA) table for RCBD.

13. The following is partially completed ANOVA table.

Source of variation	Sum of squares	Degrees of freedom	Mean Square	F
Treatments	901.19	5		
Blocks	219.43	3		
Error	229.63			
Total	1350.25	23		

Complete the ANOVA table and answer the followings:
What design was employed? How many treatments were compared? What about the total number of observations? At 5% level of significance, can we conclude that the treatments have different effects? Are the blocks homogeneous? Explain